METER ERROR REPORT

FINAL

Reconcile?	Y

Safety Issue?	N

Thesis Report No.	

1. EXECUTIVE SUMMARY

SITE NAME	Coldstream
LDZ	NGN
START DATE (actual)	Unknown
LAST GOOD DATE	23th September 2012
END DATE	30th October 2013
SIZE OF ERROR (No reconciliation required if under 0.1%)	0.8015% over-registration (1.737 GWh)
ESTIMATE – Y/N?	N
ROOT CAUSE	Failed validation checks for low DP ADC, low DP transmitter, high DP ADC and temperature ADC.
ANALYSIS	Recalculation of volumes using corrected low DP, high DP and temperature.
METER TYPE	Orifice
AUTHOR	H. Colbourne
CHECKED BY	S. Kimpton

ACCEPTED BY NGN NETWORK	B. Hanley	
RECONCILIATION	Distribution	Transportation

2. BACKGROUND

The metering at Coldstream consists of an orifice plate meter with a gas tracker used for volume correction. The following errors have occurred on stream 1

The differential pressure (DP) across the orifice plate is measured using two DP transmitters. One low ranged up to 50 mbar and one high ranged up to 500 mbar. The correct transmitter is automatically selected by the flow computer, switching up at 47.5 mbar and switching down at 45 mbar. A third standby DP transmitter with the same span as the high DP transmitter is provided for discrepancy checking.

During the annual validation the CP4b (ADC (Low DP) Check) and the CP4c (ADC (High DP) Check) tests failed on 22nd October 2013; both transmitters subsequently passed following re-calibration. The CP11a (Low DP Transmitter Check) test failed on 22nd October 2013 and subsequently passed following re-calibration of the transmitter on 30th October 2013.

During the annual validation the CP5 (ADC Temperature Check) failed on 22nd October 2013 and the test was subsequently passed following recalibration. However, the full error had not been recorded during validation as seen by the large temperature step change in the RBD data.

3. ERROR QUANTIFICATION AND IMPACT

The low DP measurement was corrected for the 'As Found' errors shown in Table 1, 2 and 3 when the recorded measurement was in the appropriate range. Table 1 includes ADC errors only; Table 2 includes ADC and transmitter errors; Table 3 includes transmitter errors only.

The high DP measurement was corrected for the 'As Found' errors shown in Table 4 when the recorded measurement was in the appropriate range.

The temperature measurement has been corrected for the step change occurring between 18th July and 22nd October 2013. The temperature has been corrected using the daily average error between Coldstream and surrounding sites (Soutra, Saltwick and Broxburn). The sites used for comparison have been chosen because they are geographically closest to Coldstream. Hume and Humbleton data has not been used due to communication issues during the period of the MER.

Corrected DP (mbar)	CP11a Error (% span)	CP4b Error (% span)	Combined Error (% span)
0.00	n/a	0.0712	0.0712
10.01	n/a	-0.057	-0.057
25.02	n/a	-0.069	-0.069
35.03	n/a	-0.0746	-0.0746
50.05	n/a	-0.0866	-0.0866

Table 1 – LDP ADC As Found errors (24th – 26th September 2012)

Corrected DP	CP11a Error	CP4b Error	Combined Error

(mbar)	(% span)	(% span)	(% span)
0.00	0.1094	0.0712	0.1806
10.01	0.1521	-0.0570	0.0951
25.02	0.2099	-0.0690	0.1409
35.03	0.2245	-0.0746	0.1499
50.05	0.2449	-0.0866	0.1583

Table 2 – LDP ADC & Transmitter As Found errors (26th September 2012 – 22nd October 2013)

Corrected DP (mbar)	CP11a Error (% span)	CP4b Error (% span)	Combined Error (% span)
0.00	0.1094	0.0012	0.1106
10.01	0.1521	0.0024	0.1545
25.02	0.2099	-0.0032	0.2067
35.03	0.2245	-0.0088	0.2157
50.05	0.2449	-0.0142	0.2307

Table 3 – LDP Transmitter As Found errors (22nd – 30th October 2013)

Corrected DP (mbar)	CP11b Error (% span)	CP4c Error (% span)	Combined Error (% span)
0.00	0.0594	0.0669	0.1263
125.12	0.0534	-0.0641	-0.0107
250.25	0.0474	-0.0427	0.0047
375.37	0.0445	-0.0770	-0.0325
500.50	0.0197	-0.0286	-0.0089

Table 4 – HDP As Found errors (24th September 2012 – 22nd October 2013)

The flow rates and daily volumes were recalculated using the measured DP & temperature and the corrected DP & temperature. The error was calculated on a daily basis as the difference between volume totals using measured and corrected values.

The overall error is an over-registration of 0.8015 %. The error is equivalent to 1.737 GWh.

4. CAUSES

Low DP ADC, Low DP transmitter, High DP ADC and Temperature ADC checks failed during routine validation.

5. RECOMMENDATIONS AND LEARNING

Failures of this type will occur occasionally, if the same checks fail regularly then it suggests a fundamental problem with the equipment being tested and repairs or replacements should be made. NGN have monitored the flow

computer in question and taken proactive steps replacing the Omni ADC card as a precaution.

The start of the error cannot be identified therefore the total error to be reconciled should be halved in accordance with the Offtake Arrangements Document. Appendix A shows the daily correction factors, which have already been halved. Appendix B shows the daily average temperature error that has been used.

On 26th September 2012, 17th September 2013, 22nd October 2013, 23rd October 2013 and 24th October 2013 a small discrepancy was found between the RBD and the Gemini data. A correction factor has been applied to these days equal to the mean correction factor for the 2 days previous and 2 days subsequent to the day on which flows were recorded.

On 30th October 2013 a small discrepancy was found between the RBD and the Gemini data. A correction factor has been applied to this day equal to the mean correction factor for the 4 days previous to the day on which flows were recorded.

REFERENCES

HPMIS Database

Coldstream_Data.xlsx – calculation spreadsheet

Coldstream_Summary.xlsx – results spreadsheet

Coldstream_Temperature_Comparison.xlsx – temperature comparison spreadsheet

VERSION HISTORY

Version	Changes	Author	Date
O	Original	H.Colbourne	05/02/2014
1	Added error in GWh Added 11/01/13 Gemini data	H. Colbourne	14/02/2014
2	NGN formatting	B. Hanley	28/02/14
3	Final Document	B. Hanley	06/03/14

DISTRIBUTION

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APPENDIX A – Daily Correction Factors

The table below shows the daily correction factors to be used to reconcile the error.

*On 26th September 2012, 17th September 2013, 22nd October 2013, 23rd October 2013 and 24th October 2013 a small discrepancy was found between the RBD and the Gemini data. A correction factor has been applied to these days equal to the mean correction factor for the 2 days previous and 2 days subsequent to the day on which flows were recorded.

** On 30th October 2013 a small discrepancy was found between the RBD and the Gemini data. A correction factor has been applied to this day equal to the mean correction factor for the 4 days previous to the day on which flows were recorded.

In both cases this was due to the routine validation work onsite.

Gas Day	Daily Correction Factor	Gas Day	Daily Correction Factor
23/09/2012	1.000000	25/10/2012	0.999024
24/09/2012	1.001261	26/10/2012	0.999053
25/09/2012	0.999945	27/10/2012	0.999123
26/09/2012	0.999767	28/10/2012	0.999225
27/09/2012	0.998997	29/10/2012	0.999018
28/09/2012	0.998867	30/10/2012	0.998901
29/09/2012	0.998957	31/10/2012	0.999042
30/09/2012	0.998914	01/11/2012	0.999081
01/10/2012	0.998898	02/11/2012	0.999087
02/10/2012	0.998649	03/11/2012	0.998961
03/10/2012	0.998836	04/11/2012	0.999092
04/10/2012	0.999027	05/11/2012	0.999186
05/10/2012	0.998604	06/11/2012	0.999123
06/10/2012	0.998948	07/11/2012	0.999058
07/10/2012	0.999185	08/11/2012	0.998999
08/10/2012	0.999044	09/11/2012	0.998759
09/10/2012	0.999059	10/11/2012	0.999044
10/10/2012	0.999130	11/11/2012	0.999228
11/10/2012	0.998735	12/11/2012	0.999068
12/10/2012	0.999073	13/11/2012	0.999077
13/10/2012	0.998829	14/11/2012	0.999062
14/10/2012	0.999087	15/11/2012	0.998883
15/10/2012	0.998989	16/11/2012	0.999120
16/10/2012	0.999128	17/11/2012	0.999069
17/10/2012	0.999022	18/11/2012	0.998997
18/10/2012	0.998810	19/11/2012	0.999019
19/10/2012	0.999029	20/11/2012	0.999068
20/10/2012	0.999232	21/11/2012	0.999073
21/10/2012	0.999066	22/11/2012	0.999196
22/10/2012	0.999054	23/11/2012	0.999054
23/10/2012	0.998933	24/11/2012	0.999004
24/10/2012	0.999283	25/11/2012	0.998901

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Gas Day	Daily Correction Factor	Gas Day	Daily Correction Factor
26/11/2012	0.999163	11/01/2013	0.999076
27/11/2012	0.999005	12/01/2013	0.998972
28/11/2012	0.999094	13/01/2013	0.999397
29/11/2012	0.999187	14/01/2013	0.999280
30/11/2012	0.999193	15/01/2013	0.999057
01/12/2012	0.999069	16/01/2013	0.999105
02/12/2012	0.999136	17/01/2013	0.999474
03/12/2012	0.999188	18/01/2013	0.999277
04/12/2012	0.999057	19/01/2013	0.999028
05/12/2012	0.999107	20/01/2013	0.998922
06/12/2012	0.999013	21/01/2013	0.999324
07/12/2012	0.998948	22/01/2013	0.999209
08/12/2012	0.999124	23/01/2013	0.999237
09/12/2012	0.999077	24/01/2013	0.998955
10/12/2012	0.999270	25/01/2013	0.999143
11/12/2012	0.999314	26/01/2013	0.998881
12/12/2012	0.999163	27/01/2013	0.998817
13/12/2012	0.999177	28/01/2013	0.999203
14/12/2012	0.999103	29/01/2013	0.999042
15/12/2012	0.999011	30/01/2013	0.998939
16/12/2012	0.998738	31/01/2013	0.998988
17/12/2012	0.998901	01/02/2013	0.999274
18/12/2012	0.999059	02/02/2013	0.999099
19/12/2012	0.999205	03/02/2013	0.998911
20/12/2012	0.999253	04/02/2013	0.999190
21/12/2012	0.999375	05/02/2013	0.998922
22/12/2012	0.999159	06/02/2013	0.999208
23/12/2012	0.998892	07/02/2013	0.999176
24/12/2012	0.998961	08/02/2013	0.999167
25/12/2012	0.998897	09/02/2013	0.999036
26/12/2012	0.999005	10/02/2013	0.999009
27/12/2012	0.999081	11/02/2013	0.998888
28/12/2012	0.999044	12/02/2013	0.999210
29/12/2012	0.999268	13/02/2013	0.999316
30/12/2012	0.998963	14/02/2013	0.974397
31/12/2012	0.999150	15/02/2013	0.999136
01/01/2013	0.998855	16/02/2013	0.998838
02/01/2013	0.999074	17/02/2013	0.998658
03/01/2013	0.999269	18/02/2013	0.999113
04/01/2013	0.999303	19/02/2013	0.999157
05/01/2013	0.999147	20/02/2013	0.999071
06/01/2013	0.999052	21/02/2013	0.999137
07/01/2013	0.999240	22/02/2013	0.999180
08/01/2013	0.999199	23/02/2013	0.999149
09/01/2013	0.999118	24/02/2013	0.999414
10/01/2013	0.999209	25/02/2013	0.999228

Gas Day	Daily Correction Factor	Gas Day	Daily Correction Factor
26/02/2013	0.999024	13/04/2013	0.998828
27/02/2013	0.998769	14/04/2013	0.998717
28/02/2013	0.998905	15/04/2013	0.999122
01/03/2013	0.998680	16/04/2013	0.999030
02/03/2013	0.999168	17/04/2013	0.999145
03/03/2013	0.998921	18/04/2013	0.999034
04/03/2013	0.998931	19/04/2013	0.997558
05/03/2013	0.998882	20/04/2013	0.998903
06/03/2013	0.998812	21/04/2013	0.999115
07/03/2013	0.998778	22/04/2013	0.999185
08/03/2013	0.998880	23/04/2013	0.998974
09/03/2013	0.998929	24/04/2013	0.998692
10/03/2013	0.999058	25/04/2013	0.998598
11/03/2013	0.999222	26/04/2013	0.999123
12/03/2013	0.998873	27/04/2013	0.999105
13/03/2013	0.999084	28/04/2013	0.999120
14/03/2013	0.998970	29/04/2013	0.965464
15/03/2013	0.998987	30/04/2013	0.999199
16/03/2013	0.998793	01/05/2013	0.998377
17/03/2013	0.998582	02/05/2013	0.998584
18/03/2013	0.999184	03/05/2013	0.998889
19/03/2013	0.999048	04/05/2013	0.998185
20/03/2013	0.999194	05/05/2013	0.998555
21/03/2013	0.999232	06/05/2013	0.998463
22/03/2013	0.999424	07/05/2013	0.997586
23/03/2013	0.999527	08/05/2013	0.998617
24/03/2013	0.998908	09/05/2013	0.991279
25/03/2013	0.999121	10/05/2013	0.998387
26/03/2013	0.999115	11/05/2013	0.998839
27/03/2013	0.999266	12/05/2013	0.998140
28/03/2013	0.998959	13/05/2013	0.999095
29/03/2013	0.999106	14/05/2013	0.999116
30/03/2013	0.999272	15/05/2013	0.998931
31/03/2013	0.999189	16/05/2013	0.998914
01/04/2013	0.998791	17/05/2013	0.997513
02/04/2013	0.998754	18/05/2013	0.998861
03/04/2013	0.999206	19/05/2013	0.998436
04/04/2013	0.999072	20/05/2013	0.999009
05/04/2013	0.999243	21/05/2013	0.998875
06/04/2013	0.999054	22/05/2013	0.997816
07/04/2013	0.999048	23/05/2013	0.999059
08/04/2013	0.998939	24/05/2013	0.999102
09/04/2013	0.999173	25/05/2013	0.998582
10/04/2013	0.998760	26/05/2013	0.998406
11/04/2013	0.999179	27/05/2013	0.998107
12/04/2013	0.999156	28/05/2013	0.998838

Gas Day	Daily Correction Factor	Gas Day	Daily Correction Factor
29/05/2013	0.998816	14/07/2013	0.994081
30/05/2013	0.998963	15/07/2013	0.995402
31/05/2013	0.998284	16/07/2013	0.997868
01/06/2013	0.996744	17/07/2013	0.997747
02/06/2013	0.997207	18/07/2013	0.994240
03/06/2013	0.998340	19/07/2013	0.983780
04/06/2013	0.998357	20/07/2013	0.983170
05/06/2013	0.998281	21/07/2013	0.981887
06/06/2013	0.998302	22/07/2013	0.980946
07/06/2013	0.996737	23/07/2013	0.982758
08/06/2013	0.998319	24/07/2013	0.982674
09/06/2013	0.998342	25/07/2013	0.981837
10/06/2013	0.998013	26/07/2013	0.981332
11/06/2013	0.998534	27/07/2013	0.977322
12/06/2013	0.995591	28/07/2013	0.973800
13/06/2013	0.996953	29/07/2013	0.981706
14/06/2013	0.997476	30/07/2013	0.980618
15/06/2013	0.998288	31/07/2013	0.981242
16/06/2013	0.997896	01/08/2013	0.980809
17/06/2013	0.995805	02/08/2013	0.979988
18/06/2013	0.998181	03/08/2013	0.979859
19/06/2013	0.997650	04/08/2013	0.980747
20/06/2013	0.986390	05/08/2013	0.980332
21/06/2013	0.997806	06/08/2013	0.981961
22/06/2013	0.996498	07/08/2013	0.982114
23/06/2013	0.998175	08/08/2013	0.981542
24/06/2013	0.998477	09/08/2013	0.982123
25/06/2013	0.997217	10/08/2013	0.980987
26/06/2013	0.998560	11/08/2013	0.980434
27/06/2013	0.998511	12/08/2013	0.979607
28/06/2013	0.998141	13/08/2013	0.979681
29/06/2013	0.996149	14/08/2013	0.980016
30/06/2013	0.998382	15/08/2013	0.980433
01/07/2013	0.996945	16/08/2013	0.979173
02/07/2013	0.998373	17/08/2013	0.979281
03/07/2013	0.997613	18/08/2013	0.980984
04/07/2013	0.995189	19/08/2013	0.980814
05/07/2013	0.998016	20/08/2013	0.981839
06/07/2013	0.997743	21/08/2013	0.980756
07/07/2013	0.997644	22/08/2013	0.982089
08/07/2013	0.998237	23/08/2013	0.982164
09/07/2013	0.996298	24/08/2013	0.981246
10/07/2013	0.997919	25/08/2013	0.982552
11/07/2013	0.998189	26/08/2013	0.982298
12/07/2013	0.997981	27/08/2013	0.982127
13/07/2013	0.997725	28/08/2013	0.980914

Gas Day	Daily Correction Factor
29/08/2013	0.982325
30/08/2013	0.981173
31/08/2013	0.980089
01/09/2013	0.980124
02/09/2013	0.981581
03/09/2013	0.981695
04/09/2013	0.980292
05/09/2013	0.979665
06/09/2013	0.979313
07/09/2013	0.979316
08/09/2013	0.980249
09/09/2013	0.980219
10/09/2013	0.980273
11/09/2013	0.979965
12/09/2013	0.980828
13/09/2013	0.980057
14/09/2013	0.979951
15/09/2013	0.978528
16/09/2013	0.979417
17/09/2013	***0.979071**
18/09/2013	0.978740
19/09/2013	0.979599
20/09/2013	0.979836
21/09/2013	0.979926
22/09/2013	0.979085
23/09/2013	0.980210
24/09/2013	0.980392
25/09/2013	0.979114
26/09/2013	0.980513
27/09/2013	0.979293
28/09/2013	0.978795
29/09/2013	0.978458
30/09/2013	0.978716
01/10/2013	0.978814
02/10/2013	0.979157
03/10/2013	0.980785
04/10/2013	0.980072
05/10/2013	0.979375
06/10/2013	0.979276
07/10/2013	0.979982
08/10/2013	0.980429
09/10/2013	0.979365
10/10/2013	0.979339
11/10/2013	0.980386
12/10/2013	0.979046
13/10/2013	0.979959

Gas Day	Daily Correction Factor
14/10/2013	0.980453
15/10/2013	0.980129
16/10/2013	0.979998
17/10/2013	0.979909
18/10/2013	0.980014
19/10/2013	0.980227
20/10/2013	0.979854
21/10/2013	0.980436
22/10/2013	***0.993399**
23/10/2013	***0.993399**
24/10/2013	***1.003938**
25/10/2013	0.998439
26/10/2013	1.014866
27/10/2013	0.998510
28/10/2013	0.998627
29/10/2013	0.998844
30/10/2013	****0.998660**
31/10/2013	1.000000
01/11/2013	1.000000
02/11/2013	1.000000
03/11/2013	1.000000
04/11/2013	1.000000
05/11/2013	1.000000

APPENDIX B – Daily Temperature Correction

The table below shows the daily temperature correction calculated using the average temperature of nearby sites (Soutra, Saltwick and Broxburn).

* The correction has only been applied from the start and resolution of the error.

Gas Day	Daily Temperature Correction (°C)	Gas Day	Daily Temperature Correction (°C)
18/07/2013	***-6.78971**	26/08/2013	-9.42695
19/07/2013	-7.31411	27/08/2013	-11.22256
20/07/2013	-9.63207	28/08/2013	-11.88650
21/07/2013	-9.26815	29/08/2013	-11.45266
22/07/2013	-9.16455	30/08/2013	-11.77957
23/07/2013	-9.73496	31/08/2013	-11.67600
24/07/2013	-9.92320	01/09/2013	-12.12631
25/07/2013	-10.49425	02/09/2013	-11.30718
26/07/2013	-10.50258	03/09/2013	-11.40814
27/07/2013	-10.15144	04/09/2013	-11.31770
28/07/2013	-11.94777	05/09/2013	-11.76283
29/07/2013	-11.42720	06/09/2013	-12.59837
30/07/2013	-12.11791	07/09/2013	-11.75987
31/07/2013	-11.66459	08/09/2013	-11.95852
01/08/2013	-11.41372	09/09/2013	-12.03074
02/08/2013	-12.08590	10/09/2013	-11.91455
03/08/2013	-11.94763	11/09/2013	-12.12678
04/08/2013	-10.72213	12/09/2013	-10.77810
05/08/2013	-12.26678	13/09/2013	-12.14507
06/08/2013	-10.13919	14/09/2013	-12.10677
07/08/2013	-11.39121	15/09/2013	-12.89266
08/08/2013	-11.51077	16/09/2013	-12.55120
09/08/2013	-11.69129	17/09/2013	-12.48328
10/08/2013	-12.14278	18/09/2013	-12.61908
11/08/2013	-11.63062	19/09/2013	-12.41482
12/08/2013	-12.80872	20/09/2013	-12.18731
13/08/2013	-12.60715	21/09/2013	-11.93610
14/08/2013	-11.87469	22/09/2013	-10.31440
15/08/2013	-12.00442	23/09/2013	-11.47671
16/08/2013	-12.42453	24/09/2013	-11.72907
17/08/2013	-12.15791	25/09/2013	-12.78232
18/08/2013	-12.37777	26/09/2013	-12.25888
19/08/2013	-11.92923	27/09/2013	-12.09062
20/08/2013	-11.16494	28/09/2013	-12.21412
21/08/2013	-10.57523	29/09/2013	-12.18078
22/08/2013	-10.85126	30/09/2013	-12.45065
23/08/2013	-10.69586	01/10/2013	-12.48402
24/08/2013	-11.18054	02/10/2013	-12.13410
25/08/2013	-10.37688	03/10/2013	-11.71335

Gas Day	Daily Temperature Correction (°C)
04/10/2013	-11.96566
05/10/2013	-12.17249
06/10/2013	-11.65013
07/10/2013	-11.61124
08/10/2013	-11.91222
09/10/2013	-12.86782
10/10/2013	-12.89897
11/10/2013	-12.33447
12/10/2013	-12.47757
13/10/2013	-12.39775
14/10/2013	-12.25281
15/10/2013	-12.38462
16/10/2013	-12.54765
17/10/2013	-12.48039
18/10/2013	-12.25794
19/10/2013	-12.09139
20/10/2013	-12.18756
21/10/2013	-11.73825
22/10/2013	***-11.48256**